US005637037A

United States Patent [19]

Bergquist

[11] **Patent Number: 5,637,037**

[45] **Date of Patent: Jun. 10, 1997**

[54] **METHOD AND GRINDING CUP FOR GRINDING BUTTONS OF A ROCK DRILLING BIT**

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[21] Appl. No.: **264,148**

[22] Filed: **Jun. 22, 1994**

[30] **Foreign Application Priority Data**

Jun. 22, 1993 [SE] Sweden 9302160

[51] **Int. Cl.**[6] **B24B 55/02**

[52] **U.S. Cl.** **451/450**

[58] **Field of Search** 451/449, 450, 451/442, 448

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[57] **ABSTRACT**

The present invention relates to a method for supplying cooling medium to a grinding cup for grinding buttons of a rock drilling bit. The invention also relates to a grinding cup to carry out the method. A shank of the grinding cup is rotatably mounted in a grinding machine. In prior art grinding cups, the cooling medium is supplied via an axial bore extending through the entire grinding cup. These prior arrangements require the cooling medium to be guided through the grinding machine. The method according to the present invention supplies cooling medium to the portion of the grinding cup that is located axially between a recess of a wear part and the free end of the shank of the grinding cup.

25 Claims, 3 Drawing Sheets

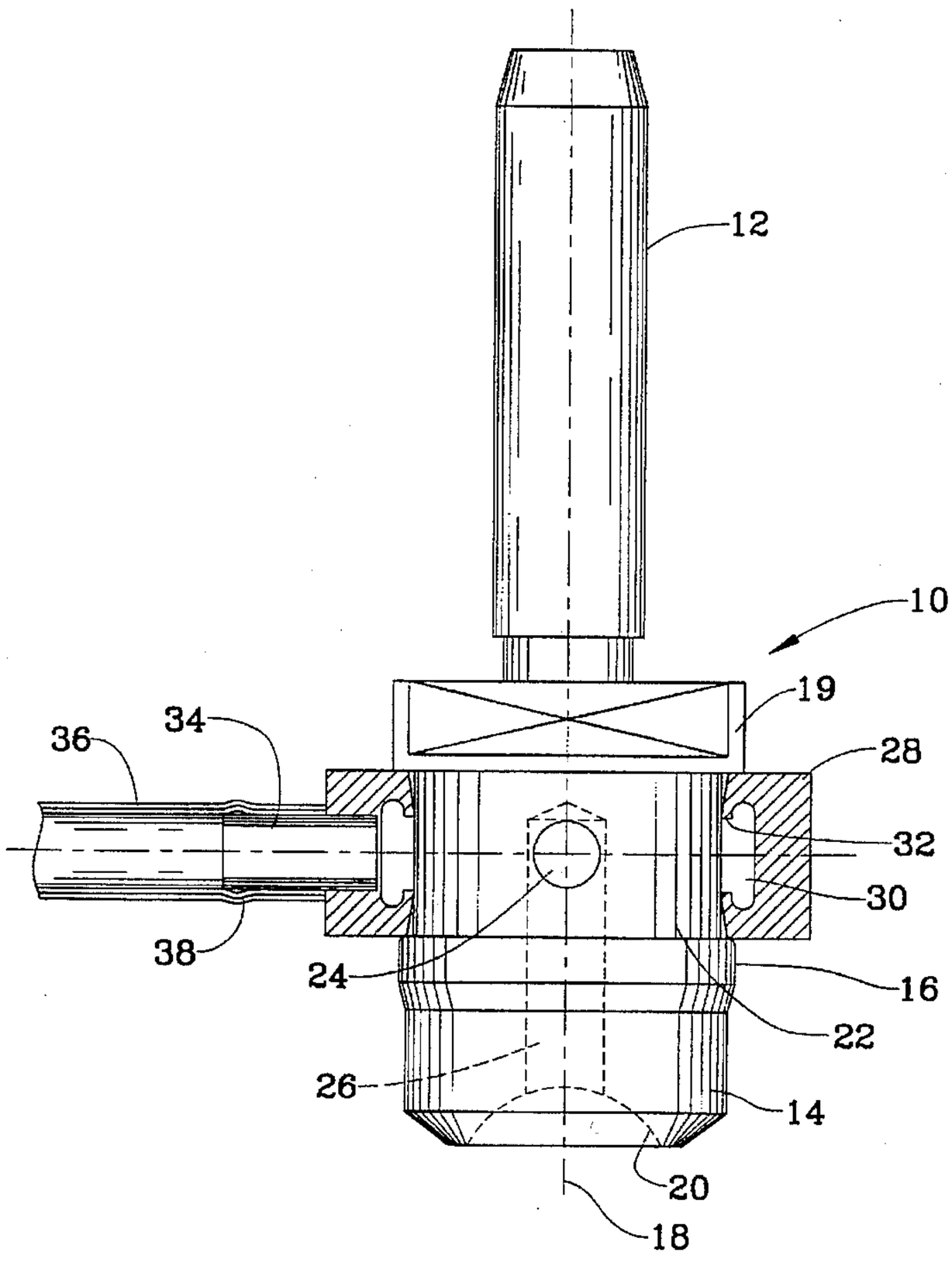


FIG. 1

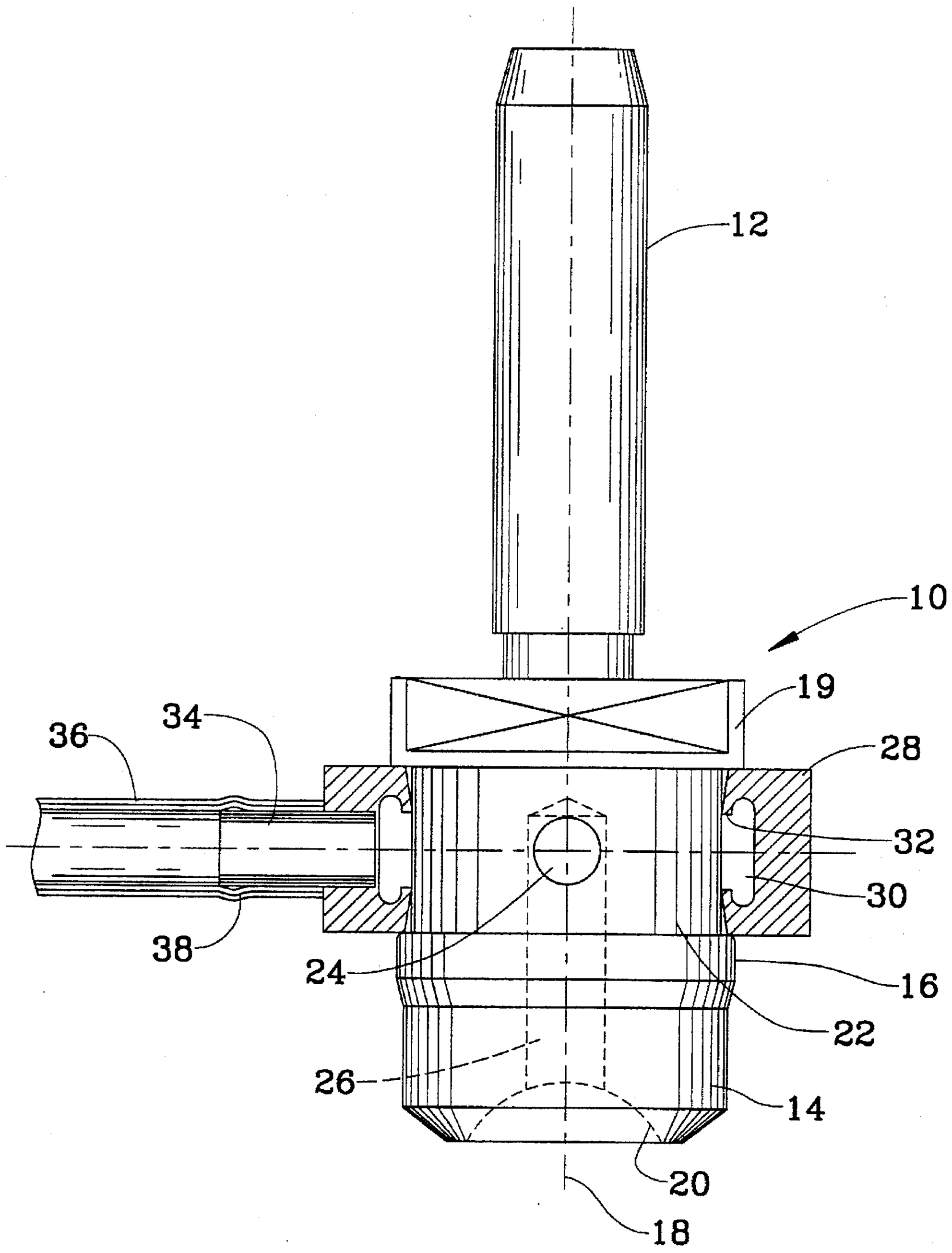


FIG. 2

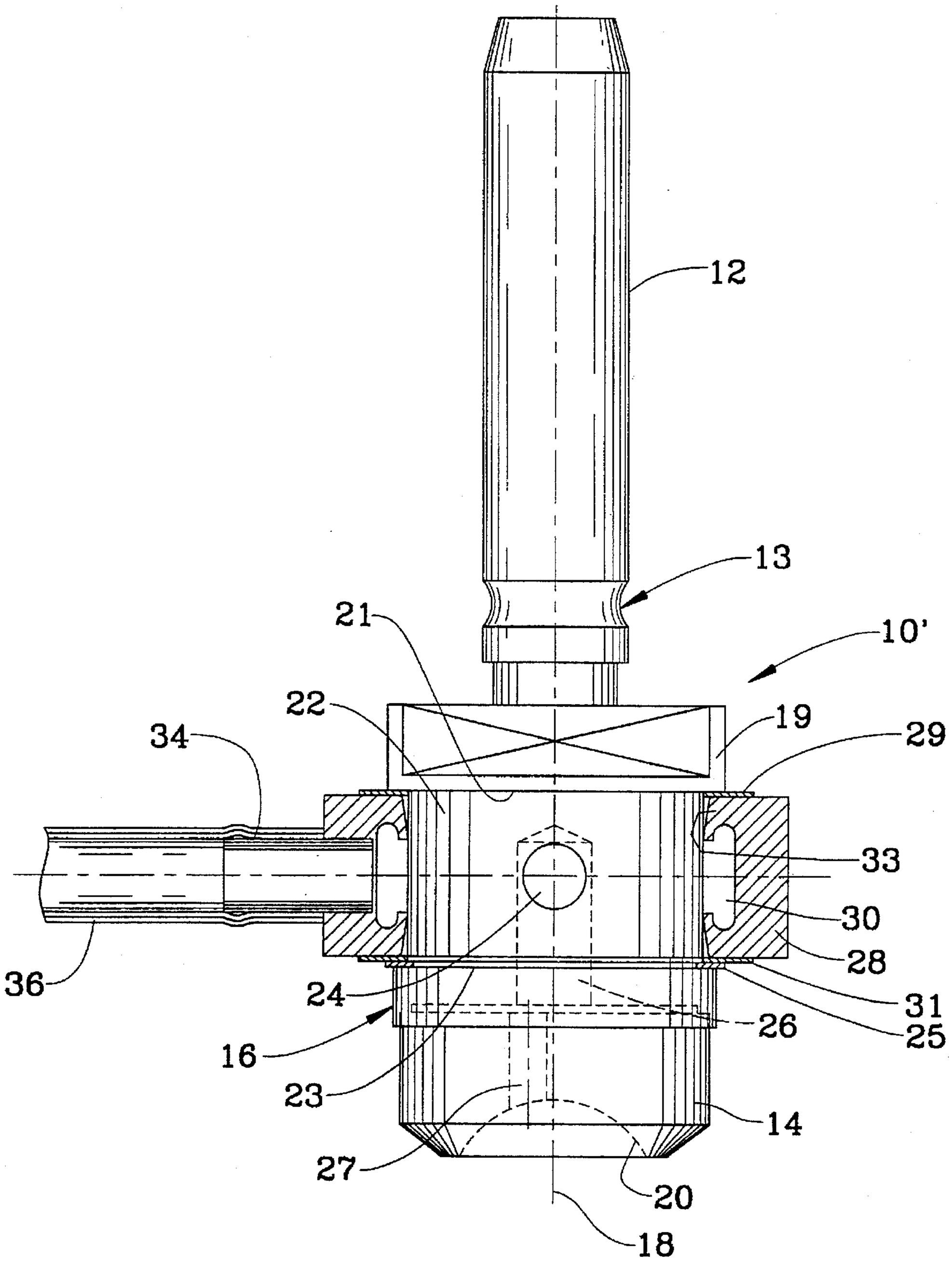
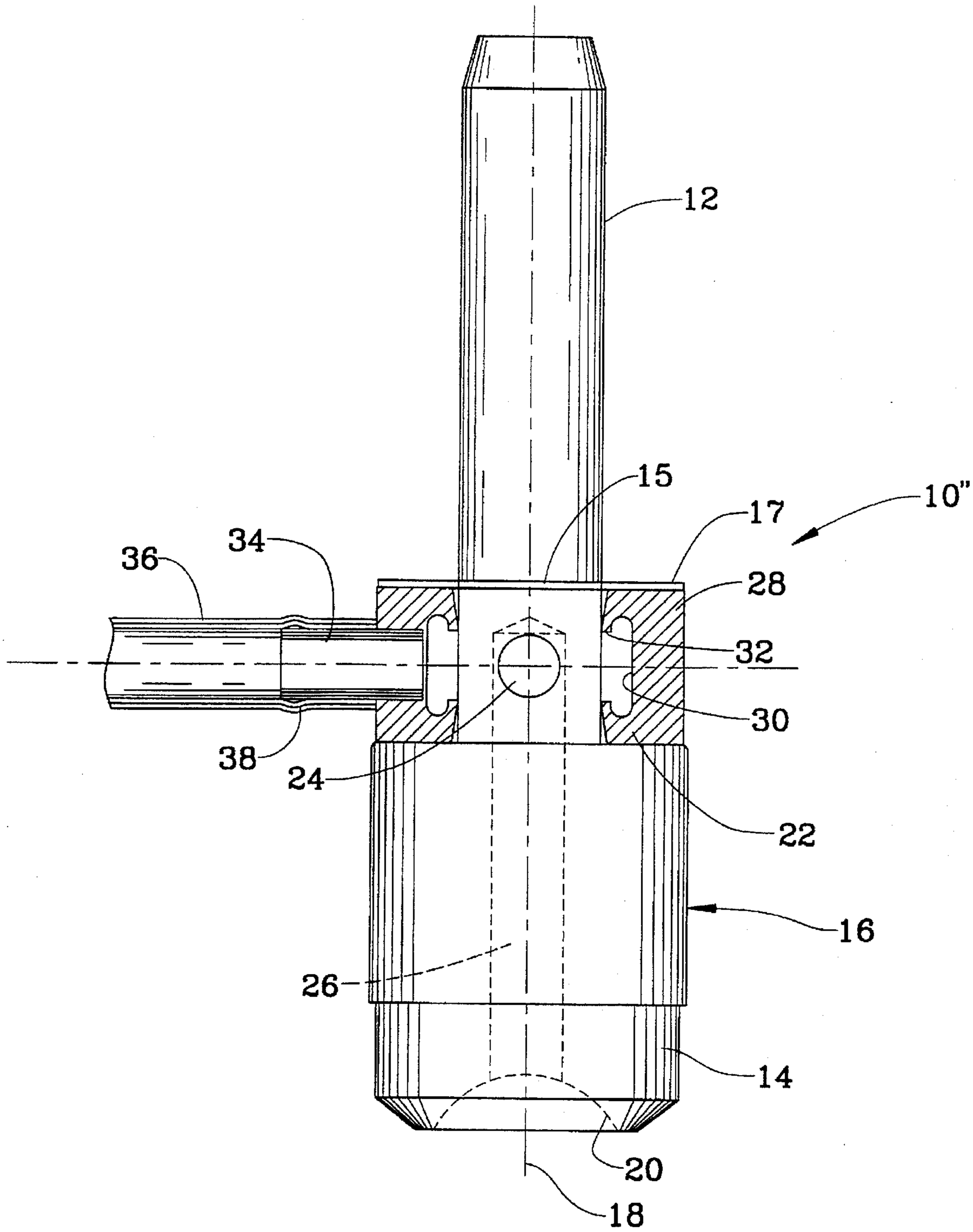


FIG. 3



METHOD AND GRINDING CUP FOR GRINDING BUTTONS OF A ROCK DRILLING BIT

BACKGROUND AND SUMMARY OF THE PRESENT INVENTION

1. Technical Field

The present invention relates to a method for supplying cooling medium to a grinding cup for grinding buttons of a rock drilling bit. The grinding cup includes a shank that is rotatably mounted in a grinding machine and a wear part having a recess. The recess carries out the grinding of the buttons. The invention also relates to a grinding cup that is intended to be rotatably mounted in a grinding machine. The grinding cup carries out grinding of buttons of a rock drilling bit. The grinding cup includes a shank and a wear part, with the wear part having a recess. The grinding cap is supplied with a cooling medium.

2. Prior Art Background

When grinding cemented carbide buttons of a drill bit, a grinding cup of the type described above is normally used. The wear part of such a grinding cup usually has an abrasive grinding surface that often includes granular diamond. However, the grinding of cemented carbide buttons generates both heat and abrasive cuttings to such an extent that it is necessary to cool the grinding cup and the button bit as well as flushing away the cuttings. The known prior art technique for such cooling is to supply cooling medium, normally water, through the grinding machine and axially through the grinding cup to provide the cooling medium to be discharged in the region where the wear part of the grinding cup engages the free end of the button. This arrangement requires that the cooling medium must be guided through the grinding machine to the rear end of a shank of the grinding cup and then axially through the shank of the grinding cup to the free end of the wear part. It is recognized that the provision of means for achieving such a cooling medium supply is a restriction from a designing point of view, i.e., when designing the grinding machine a lot of attention must be paid to the guiding of cooling medium through the grinding machine and consequently the machine may become relatively complicated.

SUMMARY OF THE INVENTION

The present invention relates to an improved method for supplying cooling medium to a grinding cup. The grinding cup is designed so that the cooling medium is not supplied via the rear end of the shank, i.e., via the grinding machine. Instead, the cooling medium is supplied to the grinding cup without entering the grinding machine. The present invention is realized by a method for supplying cooling medium to a grinding cup and a grinding cup that has been given the characteristics to accomplish that method.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with reference to the accompanying drawings wherein three embodiments of a grinding cup according to the present invention are illustrated, and wherein like members bear like reference numerals, and wherein:

FIG. **1** is a partial cross-sectioned side view of a first embodiment of the grinding cup according to the present invention;

FIG. **2** is a partial cross-sectioned side view of a second embodiment of the grinding cup according to the present invention; and

FIG. **3** is a partial cross-sectional view of a third embodiment of the grinding cup according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A grinding cup **10** according to FIG. **1** includes a shank **12**, a wear part **14** and an intermediate portion **16** that bridges the shank **12** and the wear part **14**. Preferably the shank **12** and the intermediate portion **16** are in one piece. The wear part **14** is connected to the intermediate portion **16** in a suitable way, preferably by brazing. However, within the present invention it is also possible that the wear part **14** is integral with the intermediate portion **16**. The grinding cup **10** is rotationally symmetrical relative to its longitudinal central axis **18**.

The free end of the wear part **14** has a recess **20** in the shape of a segment of a sphere when the buttons have an hemispherical free end. However, if the buttons have ballistic or conical free ends, then the recess has a complementary shape. The recess **20** is intended to engage and cooperate with the free end of a button that is to be subjected to grinding. The button is preferably made out of cemented carbide and the recess **20** is equipped with an abrasive material, preferably diamond, that can be in the shape of a matrix. If the wear part **14** is integral with the intermediate portion **16**, i.e., the wear part blank is made out of steel, the diamond layers may be adhered to the inner walls of the recess of the wear part blank by electro-plating or in some other suitable known method.

At an upper end of the intermediate portion **16** of the grinding cup **10**, a key handle **19** is provided that cooperates with driving means of the grinding machine (not shown) to rotate the grinding cup **10**. The intermediate portion **16** is further provided with a circumferential external groove **22** that has a certain extension in axial direction of the grinding cup **10**. Preferably the depth of the external groove **22** is constant. At least one hole or bore **24**, having radial direction, extends between the bottom of the external groove **22** and the region of the longitudinal central axis **18**. A second hole or bore **26**, having a primarily axial direction, extends between the area of the inner end of the first hole **24** and the bottom of the recess **20**. The first and second bores **24**, **26** communicate with each other in the area of their inner ends.

A ring **28** of flexible material, e.g., plastic or rubber, is mounted in the circumferential external groove **22**. The height of the ring **28** is somewhat smaller than or essentially equal to the height of the groove **22**. The inner periphery of the ring **28** is provided with a circumferential internal groove **30**. In the area of contact between the bottom of the external groove **22** and the inner periphery of the ring **28**, the ring **28** is preferably provided with oppositely directed tongues **32** that in an active state perform a sealing action against the bottom of the external groove **22**. In its mounted position, the ring **28** covers the opening of the hole **24**.

The internal dimensions and tolerances of the groove **22** and the ring **28** must of course be adapted to each other in such a way that when the grinding cup **10** is rotated while the ring **28** is maintained stationary, a proper sealing between the ring **28** and the groove **22** is carried out simultaneously as the friction between the ring **28** and the groove **22** is kept at a proper level.

The ring **28** is also provided with a pipe **34** that extends in a radial direction of the grinding cup **10**. The pipe **34** extends through the wall of the ring **28**. The pipe **34** is connected to the ring **28** in a substantially leak tight manner,

preferably by vulcanization. The pipe **34** extends beyond the outer periphery of the ring **28** to a certain extent in order to be able to receive a hose **36**, that is pushed onto the pipe **34**. Preferably the pipe **34** is provided with a bulge **38** to achieve a better securing of the hose **36** on the pipe **34**.

The described grinding cup **10** functions in the following way. The shaft **12** of the grinding cup **10** is mounted in the rotatable spindle of a grinding machine (not shown). The grinding cup is then adjusted in position relative to the button that is to be ground, i.e., a position where the recess in the wear part **14** engages the button. The grinding cup **10** is then rotated to perform grinding of the button. When the grinding cup **10** rotates the ring **28** remains stationary, Thus, it is important that the dimensions and mutual tolerances of the groove **22** and the ring **28** are such that the intermediate portion **16** can easily rotate relative to the ring **28**, while the supply of cooling medium can still be effected through the groove **22**, the hole **24** and the hole **26** to the recess **20**. Due to the flexibility of the ring **28**, it is possible to mount the ring **28** in the groove **22** by pushing the ring **28** over the wear part **14** into the groove **22**. The tongues **32** will deflect to allow such pushing of the ring **28** over the wear part **14**.

From an external source, cooling medium is supplied to the recess **20** via the hose **36**, the pipe **34**, the groove **30**, the first hole **24** and the second hole **26**. When the space defined by the bottom of the groove **22** and the groove **30** is pressurized by the cooling medium then the tongues **32** of the ring **28** seal against the bottom of the groove **22** and simultaneously the side walls of the ring **28** are supported by the side walls of the groove **22**. However, there is no definite requirement that this sealing is total. If there is a certain leakage of cooling medium between the tongues **32** of the ring **28** and the bottom of the groove **22**, the cooling medium will likely flow downwards and cool the outside of the wear part **14**. Such a cooling is normally favorable in the grinding action. However, the dominating part of the cooling medium should be supplied via the holes **24** and **26** to the recess **20**.

Preferably the length of the life of the ring **28** is substantially the same as the length of the life of the rest of the grinding cup **10**.

In the embodiment according to FIG. **2**, the grinding cup **10'** includes a shank **12**, a wear part **14** and an intermediate portion **16** that is integrally connected with both the shank **12** and the wear part **14**. The shank **12** is provided with a groove **13** that is intended to receive an O-ring that yieldably secures the shank **12** when mounted in the grinding machine. Preferably, the shank **12** and the intermediate portion **16** are in one piece. The wear part **14** is connected to the intermediate portion **16** in a suitable way, preferably by brazing. However, within the present invention it is also possible that the wear part **14** is integral with the intermediate portion **16**. The grinding cup **10'** is rotationally symmetrical relative to its longitudinal central axis **18**.

The free end of the wear part **14** has a recess **20** in the shape of a segment of a sphere. As explained in connection with the embodiment according to FIG. **1**, the shape of the recess can vary depending on the shape of the free end of the button. The recess **20** is intended to engage and cooperate with the free end of a button that is subjected to grinding. The button is preferably made out of cemented carbide and the recess **20** is provided with an abrasive material, preferably diamond that can be in the shape of a matrix, and may be electroplated to a steel body or in some other suitable way adhered to the steel body of the wear part **14**.

In its upper portion, the intermediate portion **16** of the grinding cup **10'** is provided with a key handle **19** that cooperates with driving means of the grinding machine to rotate the grinding cup **10'**. The intermediate portion **16** of the grinding cup **10'** is further provided with a circumferential external flange **21** that separates the key handle **19** from a sub portion **22** of the intermediate portion **16**, the key handle **19** and the sub-portion **22** having different diameters. The sub-portion **22** has a smaller diameter and a certain extension in the axial direction of the grinding cup **10'** and the extension being defined by a circumferential slot **23**. Preferably, the external diameter of the sub-portion **22** is constant. At least one hole **24**, having a radial direction, extends between the periphery of the sub-portion **22** and the region of the longitudinal central axis **18**. A second hole **26**, having at least a primarily axial direction, extends between the area of the inner end of the first hole **24** and about halfway to the bottom of the recess **20**. The first and second holes **24**, **26** are connected with each other in the area of their inner ends.

A third hole **27** extends from the region of the outer end of the second hole **26**. The third hole **27** ends in the recess **20**. As can be seen in FIG. **2**, the third hole **27** is displaced in a radial direction relative to the second hole **26** although the second and third holes or bores **26**, **27** are communicating with each other. With this arrangement the third hole **27** will open eccentrically in the recess **20** relative to the central axis **18**. In this connection it should be pointed out that the design and orientation of especially the third hole **27** can vary within the scope of the present invention. It is, knowing that the cooling fluid opening, in this case the third hole emerges in the recess **20** via a slot having a length substantially equal to the diameter of the recess **20**.

In the circumferential sub-portion **22** a first washer **29**, a ring **28** of flexible material, e.g., plastic or rubber, and a second washer **31** are mounted in consecutive order. The first washer **29** is in close contact with the flange **21**. The total height of the first washer **29**, the ring **28** and the second washer **31** is somewhat smaller than the axial extension of the sub-portion **22**. In the slot **23**, a locking ring **25** is mounted to secure the first washer **29**, the ring **28** and the second washer **31** in the axial direction. The inner periphery of the ring **28** is provided with a circumferential internal groove **30**. In its mounted position, the ring **28** covers the opening of the hole **24**. It is important that the tolerances of the cooperating dimensions of the ring **28** and the sub-portion **22** are adapted to each other, i.e., the internal diameter of the ring **28** and the external diameter of the sub-portion **22**. The sub-portion **22** must rotate relatively easily relative to the ring **28** and still there must be sufficient proper sealing action between the ring **28** and the sub-portion **22** to guide cooling medium to the recess **20** via the holes **24**, **26**, **27**.

The ring **28** is also provided with a pipe **34** that extends in the radial direction of the grinding cup **10'**. The pipe **34** extends through the wall of the ring **28**. The pipe **34** is connected to the ring **28** preferably by vulcanization. The pipe **34** extends beyond the outer periphery of the ring **28** to a certain extent in order to be able to receive a hose **36**, that is pushed onto the pipe **34**. Preferably the pipe **34** can be provided with a bulge to achieve a better securing of the hose **36** on the pipe **34**.

The grinding cup **10'** according to FIG. **2** functions principally in the same way as the grinding cup **10** according to FIG. **1**. However, the ring **28** is of slightly different design. When the space between the sub-portion **22** and the groove **30** is pressurized by cooling medium, the remaining portions **33** of the inner periphery of the ring **28** are urged apart in opposite directions to provide a sealing against the

first and second washers **29**, **31**. The first washer **29** is in its turn urged against the flange **21** to provide a sealing against the cooling medium and the second washer **31** is urged against the locking ring **25** to provide a corresponding sealing. However, what has been said in connection with the embodiment according to FIG. **1** concerning leakage of cooling medium that cools the outside of the wear part **14** applies also for the embodiment according to FIG. **2**.

The grinding cup **10"** according to FIG. **3** includes a shank **12**, a wear part **14** and an intermediate portion **16** that bridges the shank **12** and the wear part **14**. Preferably the shank **12** and the intermediate portion **16** are in one piece. The wear part **14** is connected to the intermediate portion **16** in a suitable way, preferably by brazing. However, within the present invention it is also possible that the wear part **14** be integral with the intermediate portion **16**. The grinding cup **10"** is rotationally symmetrical relative to its longitudinal central axis **18**.

The free end of the wear part **14** has a recess **20** in the shape of a segment of a sphere when the buttons have a hemispherical free end. However, if the buttons have ballistic or conical free ends, then the recess has a complementary shape. The recess **20** is intended to engage and cooperate with a free end of a button that is subjected to grinding. The button is preferably made out of cemented carbide and the interior surface of the recess **20** is provided with an abrasive material, preferably diamond that can be in the shape of a matrix. If the wear part **14** is integral with the intermediate portion **16**, i.e., the wear part blank is made out of steel, a diamond layer can be suitably electro-plated or adhered in some other suitable way to the wear part blank.

In its lower part the shank **12** is provided with at least one hole **24**, having a radial extension between the periphery of the shank **12** and the region of the longitudinal central axis **18**. A second hole **26**, having a primarily axial direction, extends between the area of the inner end of the first hole **24** and the bottom of the recess **20**. The first and second holes **24**, **26** communicate with each other in the area of their ends.

On the shank **12**, a ring **28** of flexible material, e.g., plastic or rubber, is mounted. The lower side of the ring **28** contacts the upper side of the intermediate portion **16**. The height of the ring **28** is somewhat smaller or substantially the same as the axial distance between the upper side of the intermediate portion **16** and a groove **15** that receives a snap ring **17** to lock the ring **28** in axial direction. The inner periphery of the ring **28** is provided with a circumferential internal groove **30**. In the area of contact between the shank **12** and the inner periphery of the ring **28**, the ring **28** is provided with opposite tongues **32** that in an active state perform a sealing action against the shank **12**. In its mounted position, the ring **28** covers the opening of the hole **24**. Concerning the internal dimensions and tolerances between the ring **28** and the supporting surfaces reference is made to what has been stated above in connection with the embodiments according to FIGS. **1** and **2**.

Within the scope of the present invention it is also possible that there is no groove in the shank **12** but the ring **28** is locked axially by an O-ring that is pushed onto the shank **12**.

The ring **28** is also provided with a pipe **34** that extends in a radial direction of the grinding cup **10."** The pipe **34** extends through the wall of the ring **28**, with the pipe **34** being connected to the ring **28** preferably by vulcanization. The pipe **34** extends beyond the outer periphery of the ring **28** to a certain extent in order to be able to receive a hose **36**, that is pushed onto the pipe **34**. Preferably, the pipe **34** is provided with a bulge **38** to achieve a better securing of the hose **36** on the pipe **34**.

The grinding cup **10"** according to FIG. **3** functions principally in the same way as the grinding cup **10** according to FIG. **1** or the grinding cup **10'** of FIG. **2**. However, since the grinding cup **10"** is not provided with a key handle the rotational driving of the grinding cup **10"** is preferably carried out by having a chuck of the grinding machine to clamp the shank **12** to such an extent that rotational driving of the grinding cup **10"** can be carried out. Within the scope of the present invention it is also possible to design the upper part of the shank **12** with a noncircular cross-section, e.g., a square cross-section with the cross-section engaging rotational driving means of the grinding machine. Since the ring **28** is of principally the same design for the embodiments of FIGS. **1** and **3**, the sealing by the tongues **32** is carded out in a corresponding way. What has been said in connection with the embodiment according to FIG. **1** concerning leakage of cooling medium that cools the outside of the wear part **14** applies also for the embodiment according to FIG. **3**.

Common for the described embodiments is that no axial boring through the shank need to be provided and also that the grinding machines will have an essentially simplified designed since no cooling medium supply, e.g., in the shape of borings and sealings, through the grinding machine is necessary. This means that the degree of freedom when designing grinding machines is substantially increased.

The principles, preferred embodiments, and mode of operation of the present invention have been described. However, the scope of protection sought is not limited to the particular embodiments disclosed, but is defined by the claims attached hereto.

What is claimed is:

1. A method for grinding buttons of a rock drilling bit while supplying cooling medium to a grinding cup for grinding the buttons, said grinding cup including a shank that is rotatably mounted in a grinding machine and a wear part having a recess, the method comprising the steps of grinding the buttons with an interior surface of the recess, supplying cooling medium substantially radially to a portion of the grinding cup that is located axially between the recess and a free end of the shank, and delivering the cooling medium to the interior surface of the recess, wherein the cooling medium is supplied to the grinding cup through a circumferential ring and further comprising the step of sealing the ring relative to the grinding cup.

2. The method according to claim **1**, wherein the cooling medium is supplied to an intermediate portion of the grinding cup, said intermediate portion being located axially between the shank and the wear part of the grinding cup.

3. The method according to claim **1**, wherein the cooling medium is supplied to a portion of the wear part adjacent an end of the shank of the grinding cup directed towards the wear part.

4. The method according to claim **1**, further comprising the step of supplying the cooling medium from an interior of the ring axially through the grinding cup to the interior surface of the recess.

5. The method according to claim **1**, wherein the circumferential ring is formed of flexible material, an inner periphery of said circumferential ring being provided with a circumferential internal groove.

6. The method according to claim **1**, further comprising a step of replacing the circumferential ring along with the grinding cup.

7. The method according to claim **1**, wherein the circumferential ring is formed of a flexible material and the step of

sealing the ring relative to the grinding cup is performed as a function of the flexibility of the circumferential ring.

8. Grinding cup that is intended to be mounted in a grinding machine, said grinding cup carrying out grinding of buttons of a rock drilling bit, said grinding cup comprising a shank and a wear part, said wear part having a recess shaped to receive and grind the buttons, a portion of the grinding cup located axially between the recess and a free end of the shank being provided with means for transferring cooling medium from an outside source to the recess of the wear part, wherein the means for transferring cooling medium includes a circumferential ring and the cooling medium is transferred through the circumferential ring.

9. The grinding cup according to claim **8**, wherein the portion of the grinding cup located axially between the recess and the free end of the shank is an intermediate portion located between the shank and the wear part.

10. The grinding cup according to claim **8**, wherein the portion of the grinding cup located axially between the recess and the free end of the shank is a portion of the wear part adjacent an end of the shank directed towards the wear part.

11. The grinding cup according to claim **8**, wherein the circumferential ring is formed of flexible material, an inner periphery of said circumferential ring being provided with a circumferential internal groove.

12. The grinding cup according to claim **11**, wherein the ring is provided with means for connection to a cooling medium source, said means transferring cooling medium to the internal groove of the ring.

13. The grinding cup according to claim **11**, wherein a space provided between the internal groove of the ring and the grinding cup communicates with the recess of the wear part.

14. The grinding cup according to claim **11**, wherein the ring includes two circumferential tongues on a radially inside surface that contact an outer portion of the grinding cup.

15. The grinding cup according to claim **11**, wherein the circumferential ring is received in a circumferential groove in the grinding cup.

16. The grinding cup according to claim **8**, wherein the means for transferring the cooling medium to the recess includes both a radial and an axial bore.

17. The grinding cup according to claim **16**, wherein the radial bore extends inwardly from a circumferential groove in the grinding cup.

18. The grinding cup according to claim **16**, wherein the recess is of a concave cup shape and the axial bore opens into the recess radially displaced from a rotational axis of the grinding cup.

19. Grinding cup for grinding buttons of a rock drilling bit, said grinding cup comprising a shank and a wear part, said wear part having a recess for receiving and grinding the buttons, an intermediate portion of the grinding cup located axially between the recess and a free end of the shank, the intermediate portion having an outer peripheral surface, the outer peripheral surface of the intermediate portion provided with a circumferential groove, means for transferring cooling medium from an outside source to the circumferential groove, and connecting means for transferring the cooling medium from the circumferential groove to the recess of the wear part.

20. The grinding cup according to claim **19**, wherein the means for transferring cooling medium from an outside source to the circumferential groove includes a circumferential ring.

21. The grinding cup according to claim **20**, wherein the circumferential ring is formed of a flexible material, an inner periphery of the circumferential ring being provided with a circumferential internal groove.

22. The grinding cup according to claim **19**, wherein the circumferential groove forms a seat for the circumferential ring.

23. A grinding apparatus for grinding buttons of a rock drilling bit comprising:

a grinding machine;

a grinding cup removably attached to the grinding machine, the grinding cup having a shank and a wear part, said wear part having a recess configured for receiving and grinding the buttons, an intermediate portion of the grinding cup located axially between the recess and a free end of the shank being provided with means for transferring cooling medium from an outside of the intermediate portion to the recess of the wear part; and

a delivery means for delivering the cooling medium from an outside source to the outside of the intermediate portion, the delivery means being connected to the intermediate portion only and displaced from the grinding machine.

24. The grinding apparatus of claim **23**, wherein the delivery means is a circumferential ring of flexible material which forms a seal around a part of the intermediate portion.

25. The grinding apparatus of claim **24**, wherein the circumferential ring is placed in a circumferential groove formed in the intermediate portion.

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